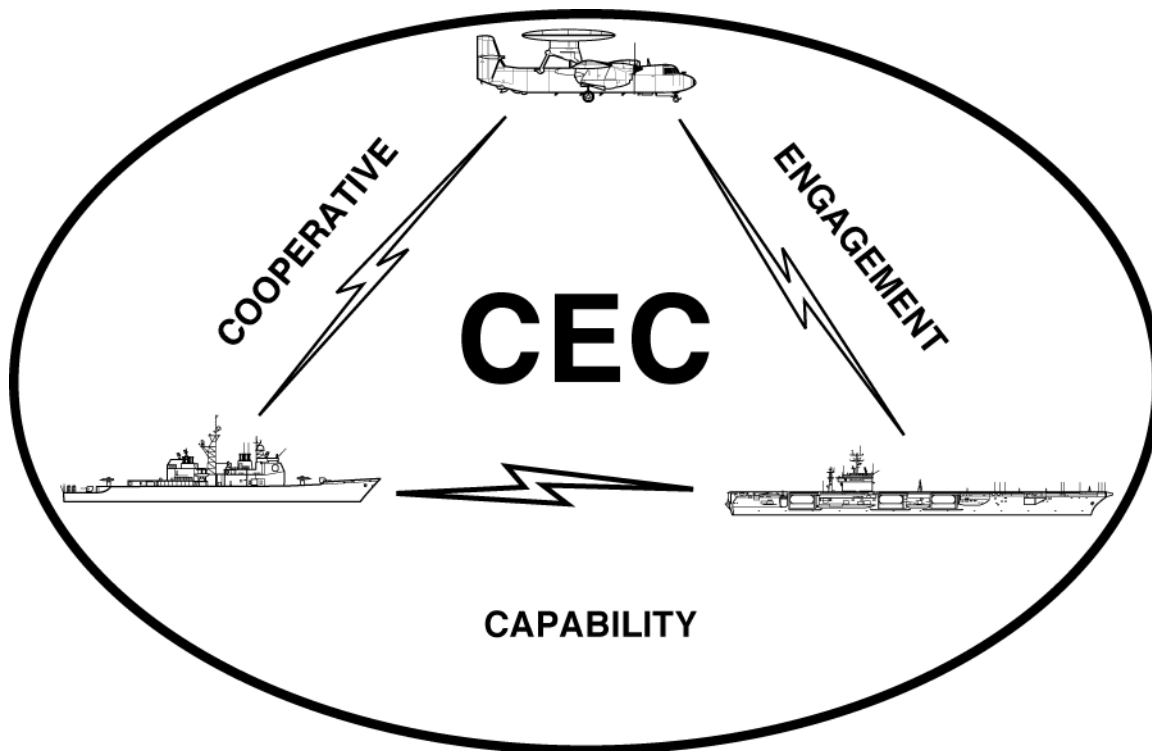


COOPERATIVE ENGAGEMENT CAPABILITY (CEC)



Navy ACAT IC Program

Total Number of Systems:	215
Total Program Cost ((TY\$):	\$3,576.1M
Average Unit Cost (TY\$):	\$77.9M
Full-rate production:	FY02

Prime Contractor

Raytheon Systems Corporation
St. Petersburg, FL

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

Cooperative Engagement Capability (CEC) is a system of hardware and software that allows the sharing of radar data on air targets among ships. Radar data from individual ships of a Battle Group is transmitted to other ships in the group via a line of sight, data distribution system (DDS). Each ship uses identical data processing algorithms resident in its cooperative engagement processor (CEP), resulting in each ship having essentially the same display of track information on aircraft and missiles. An individual ship can launch an anti-air missile at a threat aircraft or anti-ship cruise missile within its engagement envelope, based on radar data relayed to it by another ship. Program plans include the addition of E-2C aircraft equipped with CEP and DDS, to bring airborne radar coverage plus extended relay capability to CEC. CEP-equipped units, connected via the DDS network, are known as Cooperating Units (CUs).

As currently implemented, CEC is a major contributor to the *Joint Vision 2010* concept of *full-dimensional protection* for the fleet from air threats. In concert with multi-Service sensor and engagement systems, it can contribute to a major expansion of the battlespace.

BACKGROUND INFORMATION

An at sea demonstration of CEC was conducted during FY90. An early operational assessment was conducted in FY94, based on results of at-sea developmental testing, including missile firings at the Atlantic Fleet Weapons Training Facility in Puerto Rico. Although there were significant test limitations, we concluded that CEC is potentially operationally effective and potentially operationally suitable. We also observed that this assessment must be tempered with the caveat that CEC has not undergone OT&E with the attendant operational realism. Approval to begin EMD (Milestone II) was granted in May 1995. An additional early operational assessment (OT-1A) of the airborne component of the CEC network was conducted in September 1995. In accordance with congressional guidance, the Navy certified IOC for CEC (engineering development model equipment upgraded to AN/USG-1) in late FY96.

OT&E to support the initial LRIP decision of AN/USG-2 equipment was conducted in August 1997. Although CEC was assessed as being potentially operationally effective and potentially operationally suitable, significant problems were observed in Battle Group interoperability and in software reliability. Interoperability problems experienced in early 1998 at-sea testing with the latest Aegis Weapon System software involved CEC, as well as the Aegis Weapon System, ACDS Block 1, and the command and control processor for the tactical data links. Deficiencies were in the areas of track management, net operations, cooperative engagement, engagement support, composite identification, and link interoperability. This resulted in freezing the CEC software configuration (Baseline 2) and decelerating CEC development so that associated system software (Aegis Weapon System (AWS) Baseline 6.1 and Advanced Combat Direction System (ACDS) Block 1) could reach maturity. An important lesson from this was that CEC is but one element of a larger system of systems, with the proper integration of elements essential for operationally effective and suitable operation. As a result, the PEO implemented an analytical and management structure to examine test data from the major subsystems: AWS, ACDS Block 1, CEC, and the tactical data link command and control processor. Through collaborative analysis between the major subsystem teams, rapid feedback was provided to a senior system engineering council that made recommendations to the PEO regarding software modifications to enhance overall system performance. In addition, the Naval Sea Systems Command initiated the definition of battle force level interoperability requirements.

The re-planned program, challenged by the requirement to synchronize testing with fleet deployment schedules, includes DT and combined DT/OT in 2000, followed by TECHEVAL and OPEVAL in 2001. The full production decision is expected during the 1QFY02.

TEST & EVALUATION ACTIVITY

Developmental and engineering testing were conducted during FY99. Developmental testing of CEC Baseline 2 was conducted in July 1999 with USS CAPE ST GEORGE (using AN/USG-1 hardware and AWS Baseline 5.C software) and at the Aegis Combat Systems Center (ACSC). ACDS Block 1 participants in the testing were the amphibious assault ship, USS WASP and the land based test site at Dam Neck, VA. ACSC, USS WASP, and the Dam Neck test site used AN/USG-2 hardware. Connectivity between the land sites was provided by a relay tower at Eastville, VA. A P-3 aircraft with CEC relay capability also participated. An OT phase was canceled because the system was not sufficiently mature and fleet schedule constraints prevented sufficient testing, training, and preparation for OT.

Several phases of engineering testing were conducted with ships configured with CEC AN/USG-2 hardware and Baseline 2 software. These were with the two Aegis cruisers, USS HUE CITY and USS VICKSBURG, both equipped with AWS 6.1. The aircraft carrier, USS JOHN F. KENNEDY, with the Advanced Combat Direction System (ACDS) Block 1, participated during some phases (although in a non-DDS configuration, as the ship is currently deployed), as did a P-3 aircraft with relay capability. The land-based test sites at the Aegis Combat Systems Center (ACSC), Wallops Island, VA and at the Fleet Combat Systems Center, Dam Neck, VA, were used extensively. This testing focused on demonstrating stability with the system interfaces, ensuring integration of the systems, and checking software improvements.

Other activity during FY99 included extensive examination of data from FY98 engineering tests conducted with the AWS 6.1 ships, the ACDS Block 1 ships, and the land based test sites. Determination of interoperability problem causes led to software changes in CEC, AWS 6.1, ACDS Block 1, and the Tactical Data Link command and control processor (C2P). The effectiveness of these changes will be a focus of at-sea testing conducted in 2000. Data from FY99 testing is being examined to determine if further problems exist that warrant future software changes.

TEST & EVALUATION ASSESSMENT

CEC performance during the July 1999 Developmental Testing was markedly improved over testing conducted in FY97, particularly in the areas of system reliability and availability.

Adequacy, in terms of risk reduction, of the overall T&E program leading to the CEC OPEVAL is dependent on the extent to which this "system of systems" is immersed in an operationally realistic test environment early enough in 2000. The stressing, operationally realistic environment is required to have problems become evident, as they otherwise will when the system has to operate in the fleet. Moreover, this stressing testing has to occur in time to have the causes of observed problems diagnosed and solutions implemented and tested before OPEVAL in 2001. Thus, challenging scenarios, involving a substantial number of CUs, are required to demonstrate CEC ability to exchange sensor data effectively and form composite tracks that can support engagement. The ability to provide such scenarios is site-dependent. The current testing proposal for pre-OPEVAL OT is for conducting it in the Virginia Capes area only, where range interference by fishing and pleasure craft is a significant detractor from achieving realism, precluding adequate representation of low altitude threat profiles. Pre-OPEVAL testing in the Puerto Rican operating area, where boat traffic is at a much lower level, is for DT only. Unless the DT scenarios are more operationally realistic, this will be an opportunity lost. This—only DT in the Puerto Rican area—is viewed as a potential weakness in the risk reduction in preparation for OPEVAL. PEO(TSC) recognizes this risk and is working closely with COMOPTEVFOR to make the DT scenarios conducted in Puerto Rico as operationally realistic as possible.

Synchronization of OPEVAL with fleet deployment schedules remains a challenge. This is due in part to the requirement to have an adequate number of ship CUs. From an OT&E perspective, ensuring that enough CUs participate in the CEC net during end-to-end (detection through intercept of targets representing anti-ship cruise missiles) testing, is critical to achieving a realistic environment for operational evaluation of this complex system prior to its delivery to fleet operators.

As this report is being written, availability of a second Big Crow aircraft for jamming during the OPEVAL is unresolved. This type of aircraft is required for jamming the DDS link, as well as the Aegis radars. A single aircraft cannot do both. More than one aircraft is required for multi-axis jamming and,

during part of the OPEVAL, two battlegroups will be involved. A single aircraft cannot jam two groups at the same time.

This “system of systems” using different ship classes and aircraft, is replete with interoperability challenges, as well as the potential for significant progress toward realization of a single integrated air picture for Battlegroup units. The Navy is addressing the interoperability challenges. The collaborative assessment process and the system of rapid feedback, based on testing results regarding software design changes, appear to be working. Both of these processes could establish a pattern for emulation by other acquisition managers challenged with the development and delivery of complex, highly interactive “systems of systems.”